

MANAYUNKIA SPECIOSA.

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At the time of the discovery of the pretty polyzoan, *Urnatella gracilis*, of which a description is now in course of publication in the Journal of the Academy, I found an equally interesting little annelide, of which I gave a brief notice in 1858, published in the Proceedings for that year, page 90, under the name of *Manayunkia speciosa*. The two were found in company together, attached to the same stones, in the Schuylkill River, at Fairmount, Philadelphia. They seem fitting associates, for while *Urnatella* is nearly related with the marine *Pedicellina*, *Manayunkia* is closely related with the marine annelide *Fabricia*. *Manayunkia* has proved to be less frequent than *Urnatella*, nor have I found it elsewhere than in the locality named. Recently, several specimens were submitted to my examination by our fellow-member, Mr. Edward Potts, who found them attached to a fragment of pine-bark, in Egg Harbor River, New Jersey. Independent of the interest of finding the worm in a new locality, the specimens have enabled me to complete an investigation of the animal so far as to prepare the following description, though I have to regret that the material has been insufficient to allow me to clear up several important points. I have had the opportunity of comparing *Manayunkia* with a species of *Fabricia* living on our coast, and have found the two to be so nearly alike, that I am prepared to hear it questioned whether the former should be regarded as generically distinct from the latter.

Manayunkia forms a tube of mud, which it occupies. The tube is composed of the finest particles, agglutinated by a mucoid secretion of the worm. It is cylindrical, straight or bent, mostly even or slightly uneven on the outside, and sometimes feebly annulated. It is attached partly along its length to fixed objects, with the greater part free, directed downward and pendant. Most specimens observed were single, but several were found in which two or three tubes were conjoined, and in one instance five tubes with remains of others were given off, in a candelabra-like manner, from a common stem, as represented in fig. 2, Plate IX. From the open mouth of the tube, the worm protrudes its head and spreads its crown of ciliated tentacles, in the same manner as in

most tubicolous annelides. The simple tubes range from two to four lines in length by the one-fifth to the one-fourth of a line in width.

Manayunkia is very sensitive, and on disturbance withdraws deeply into its tube, so that half the length of the latter may be removed before reaching the worm. The little creature clings tightly to the inside of its habitation, apparently mainly by means of the minute podal hooks of the posterior segments of the body.

The mature worm (fig. 1) is from three to four millimetres in length by about one-fourth of a millimetre in breadth, and is divided into twelve segments, including the head. The color is translucent olive-green, with the cephalic tentacles of a slightly brownish hue. As the worm shortens, the segments become more bulging laterally and the constrictions deeper; in elongation, the segments become more cylindrical and the constrictions less marked. When the worm is elongated, it is of nearly uniform width for about three-fourths of the length, and then slightly tapers to the end, or is a little widened again in the two segments before the last. The head is about as broad as it is long, and is surmounted by a pair of lateral lophophores supporting the tentacles. Its border above projects dorsally into a short rounded process. The succeeding four segments of the body are about as broad as they are long, and nearly of uniform size; the next one is somewhat longer than those in advance. The seventh segment, in all the mature worms observed, greatly exceeded any of the others. It was usually twice the length, and differed from them in having an abrupt expansion at the fore-part, which suggested the production of a head prior to division of the worm; a process, however, if it occurs in *Manayunkia*, I had not the opportunity of observing. The succeeding segments, smaller than the anterior ones, differ little in size, except the last two. The terminal segment abruptly tapers from above its middle in an obtusely rounded extremity. When the worm protrudes from its tube, the lophophores are reflected from the head, and they exhibit a double row of tentacles extending forward. The number of tentacles varies with the age of the worm, but at maturity there are usually eighteen for each lophophore. They are of moderate length, and of uniform extent, and measure about half a millimetre. Two of them internally, one for each lophophore,

are rather longer and larger than the others, and are rendered conspicuous by a large vessel filled with bright green blood. The tentacles are invested with ciliated epithelium, with actively moving cilia, and in all respects bear a close resemblance to those of the polyzoa. In the allies of *Manayunkia*, they are regarded as branchial appendages, and usually named cirri; and although this is unquestionably correct, as in the case of the corresponding organs of the polyzoa, they perform a varied function, and may, with equal correctness, be called tentacles.

When *Manayunkia* is about to withdraw into its tube, the lophophores approach, and together with the tentacles form a close longitudinal fascicle. Along the lophophores, at the base of the tentacles, there is a row of half a dozen or more brownish pigment spots, resembling eyes, but not having the usual constitution of such organs. The segments of the body of *Manayunkia*, succeeding the head, are furnished on each side with a fascicle of locomotive setæ, which is divided into two portions, one usually consisting of shorter setæ than the other. The fascicles, when most protruded, project from a papilla, which disappears with the partial retraction of the former. They are projected directly outward or in a slanting manner either forward or backward, and are moved in the same manner and by the same arrangement of muscles as in other chætopods. The number of podal setæ is from four to ten in each fascicle. In several mature individuals the numbers in the different segments were as follows: 8 to 10 setæ in the first to the sixth segment; 6 to 7 in the three succeeding ones; 4 or 5 in the tenth, and 3 or 4 in the last segment.

The setæ, figs. 3, 4, of the anterior segments are longest, and range from about 0.15 to 0.25 mm. in length. They consist of a long, straight rod, with a linear-lanceolate blade tapering into a long filament. The rod varies little in length in the different setæ; but the blade varies considerably in this respect. The blade is more or less bent from the rod, and is longest in the longer setæ.

Except the head and the first setigerous segments, the others are provided on each side with a fascicle of podal hooks, which are situated ventrally behind the bottom of the podal setæ. The hooks are 4 or 5 in each fascicle in the setigerous segments from the second to the eighth inclusive, and are very different from those of the succeeding segments. The podal hooks, fig. 5, of the

anterior segments, are about 0.05 to 0.06 mm. long, and consist of a long curved handle, ending in a small recurved hook.

The podal hooks of the posterior three setigerous segments form close transverse rows, fig. 6, of variable number, from 9 to 24 in each row. The hooks are minute, and measure from 0.025 to 0.03 mm. long. They consist of a broad handle, ending in a lateral comb-like extremity, as represented in figure 7.

The number of podal setæ and podal hooks is more or less variable in the corresponding segments of different individuals, and frequently also on the two sides of the segments of the same individual. The difference is due sometimes to the accidental loss of some of the appendages; sometimes probably to circumstances interfering with their development. In several specimens the following differences were observed :

SPECIMEN 1.

First segment, 6 and 8 setæ.

Second to fourth segment, inclusive, 8 to 10 setæ and 4 to 5 hooks.

Fifth to eighth segment, inclusive, 6 to 8 setæ and 4 to 5 hooks.

Ninth segment, 6 setæ and 9 and 22 hooks.

Tenth segment, 4 setæ and 12 and 18 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 2.

First segment, 8 setæ on each side.

Second to sixth segment, inclusive, 8 setæ and 4 hooks on each side.

Seventh and eighth segments, 6 or 7 setæ and 4 hooks, except on one side of the eighth segment, in which another fascicle of 6 setæ substituted the usual fascicle of hooks.

Ninth segment, 6 setæ on each side and 9 and 20 hooks.

Tenth segment, 4 and 5 setæ and 13 and 16 hooks.

Eleventh segment, 3 and 4 setæ and 12 hooks on each side.

SPECIMEN 3.

First segment, 8 setæ each side.

Seven succeeding segments, 6 to 10 setæ and 3 to 4 hooks each side.

Ninth segment, 7 setæ and 24 hooks each side.

Tenth segment, 3 setæ and 18 hooks, but on one side the latter were all imperfect, mostly with the comb undeveloped.

Eleventh segment, 2 setæ and 14 hooks each side.

In the last specimen the rows of 24 hooks in the ninth segment measured 0.08 mm. wide; the rows of 18 hooks of the tenth segment 0.072 mm. wide; and the rows of 14 hooks of the last segment 0.06 mm. wide. The height of the rows corresponding with the length of the hooks was 0.025 mm.

The intestinal canal of *Manayunkia* is of extreme simplicity, consisting of a median tube alternately dilated within the segments and contracted in the intervals of the latter, without any other conspicuous division into more distinct portions. The widest expansions are within the fourth to the seventh segment, inclusive, but are also variable in these. Afterwards the intestine becomes narrower to the anus, which opens ventrally in the last segment. The mouth is funnel-like, capacious, and without armature of any kind. Along the intermediate two-thirds of the canal the walls are of a yellowish brown hue. Within the intestine in the seventh segment, and within the terminal portion, active ciliary motion was observed. The intestine, as usual in other annelides, is connected by thin diaphragms to the wall of the body-cavity in the intervals of the segments. The intervals are occupied with liquid with multitudes of floating corpuscles.

The ovaries, with ova in different stages, occupy the fourth to the sixth segment inclusive. Within the lower part of the head, extending thence into the third segment on each side, there is a large elliptical organ, which I have suspected to be the testicle, though I did not examine its structure.

I was greatly puzzled in the attempt to ascertain the arrangement of the vascular system of *Manayunkia*, and am in doubt as to the following explanation I give of it. The blood is of a bright green color, and in many positions serves clearly to define the course of the larger vessels. As represented in figure 1, the chief blood-vessels appear to be a large one on each side of the intestinal canal, closely following the course of this so as to seem to form a green coat to it. In each segment of the body the vessel gives off a pair of lateral branches apparently uniting in a loop. In the head the two main vessels leave the sides of the intestine, and after forming a close flexure or a sinus at the base of each lophophore, proceed onward through the interior of the larger pair of tentacles. In viewing the worm in any direction, the two main vessels so constantly appeared at the sides of the intestine, that I at first took them for the walls of the latter itself. The condi-

tion I did not comprehend until I found an explanation in the following paragraph in Claparede's *Recherches sur la structure des Annelides Sedentaires*, Geneva, 1873, page 76: "M. de Quatrefages has discovered that in certain Serpuliens," to which family *Fabricia* and *Manayunkia* belong, "the intestinal canal is enclosed in a lacuna or rather a veritable sheath taking the place of a dorsal vessel." Claparede adds from his own observations the statement "that a number of the sedentary annelides present the same peculiarity of having the intestine included in a vascular sheath playing the part of a dorsal vessel." In this view the two chief vessels, in figure 1, at the sides of the intestine, are to be regarded as sections of the vascular sheath enclosing the latter. The principal movement observed in the vessels of *Manayunkia*, consisted in an incessant pumping of blood into those of the two larger tentacles alternating with contraction and partial expulsion of blood from the same.

The nervous system of *Manayunkia* I did not attempt to investigate. A well-developed eye occupied the head at the side of the gullet. It exhibited a clear vitreous humor in a choroid cup. No trace of eyes was to be detected in the terminal segment of the body, such as exist in *Fabricia*.

In several instances in which I have extracted *Manayunkia* from its tube, a number of young ones, about half a dozen, have been liberated, from which it appears that the eggs are laid within the tube, there hatched, and the young then retained under the care of the parent until sufficiently developed to be able to care for themselves.

Figures 8-13, Pl. IX, represent an ovum and a series of young in different stages of development, which were obtained together with others in the same condition from three tubes.

The ovum, fig. 8, about 0.2 mm. long, obtained with several similar ones from a tube, exhibits a central mass of large, yolk-cells enclosed by a layer of smaller ones. Fig. 9 represents an embryo, which accompanied the former. It was motionless and devoid of cilia. The yolk-cells appear to have been resolved into a stomachal cavity. The embryo was about the same size as the ovum. Fig. 10 represents a more advanced embryo, from the same tube. It measured 0.265 mm. in length. The intestine indicates a division into eight segments. Fig. 11 is a more advanced stage of development of the worm from another tube.

It measured one-third of a millimetre in length. The body-wall and intestine are quite distinct, the latter exhibiting eight segments. The tentacular lobes have commenced development. Fig. 12 represents an individual further developed, from the same tube as the former. It measured half a millimetre long. The body is distinctly divided into nine segments, of which eight bear a pair of setae on each side. The tentacular lobes exhibit each the rudiments of four tentacles. Eyes also have made their appearance. Fig. 13 represents a young worm, from another tube, the only one accompanying its parent. It measured 0.72 mm. long. The body is divided into the same number of segments as in the former. The tentacular lobes have developed each four tentacles with the rudiment of a fifth. Podal hooks could be detected in none of the segments except the last, in which there were three comb-hooks on each side. Another young individual observed, from another tube, about the same size of the preceding, had five tentacles on each side, but was otherwise exactly similar. Another individual three-fourths of a millimetre long, with five tentacles on each side, had one more setigerous segment than in the others.

The species of *Fabricia* to which I referred in the beginning of the present communication, and which I examined with particular interest on account of the near relationship of *Manayunkia* to it, is the same as that described by Prof. Verrill, as being common from New Haven to Vineyard Sound and at Casco Bay (see Report on the Sea Fisheries of New England, Washington, 1873, p. 619). I first noticed the worm at Newport, Rhode Island, in 1858, and found it abundantly at Bass Rocks, Gloucester, Mass., in 1882. It occurred on rocks between tides, under a luxuriant growth of *Fucus vesiculosus*, with its tubes projecting from among the mud and sand firmly fixed together with multitudes of little mussels about the roots of the sea-weed.

The worm is three or four millimetres long and of a yellowish or yellowish brown hue, with more or less reddish. The body is compressed cylindrical and slightly tapering behind, and is divided into twelve segments, including the head. This is prolonged dorsally in a half elliptical process or upper lip. The vertex supports on each side a trifurcate lophophore, each fork of which is provided with a double row of narrow cylindrical tentacles invested with cilia.

The segments succeeding the head are furnished with lateral fascicles of podal setæ, and, except the first one, are provided with fascicles of podal hooks, all of which have the same general arrangement and form as those described in *Manayunkia*. The fascicles of podal setæ, from the first to the eighth segments, usually contain six or seven setæ; those of the ninth and tenth segments, three or four setæ; and those of the eleventh segment two or three setæ. The longer setæ, figs. 14, 15, resemble those of *Manayunkia*, consisting of a straight rod with a feather-like vane ending in a long point and bent at an obtuse angle from the rod. The stouter setæ, fig. 16, have the same form, but differ in the variably much shorter proportion of the vane. The setæ range from 0.12 to 0.25 mm. long.

The first setigerous segment possesses no podal hooks, as in the case of *Manayunkia*. The fascicles in the succeeding segments to the fourth contain each eight or nine hooks, and those following to the eighth, inclusive, six or seven hooks. The hooks of the remaining three segments, as in *Manayunkia*, are very different from those of the anterior segments, and are arranged in close transverse semicircular rows of from 20 to 28 in each row.

The anterior podal hooks consist of a curved handle ending in a short robust hook, like those of *Manayunkia*, but differing in the hook being furcate, or even divided three or four times on the dorsum, as represented in figs. 17, 18. These podal hooks usually measure about 0.08 mm. long.

The posterior podal hooks resemble the corresponding ones of *Manayunkia* as represented in fig. 19. They measure from 0.035 to 0.04 mm. long.

The intestinal canal of *Fabricia* has the same simple character as that described in *Manayunkia*. The mouth has a pair of palp-like appendages, situated between the lophophores. The vascular system appears to exhibit the same arrangement as in *Manayunkia*, but the blood is of a red color.

Fabricia is remarkable for being furnished with a pair of eyes to the terminal segment of the body as well as to the head. The eyes are of simple character, but equally well developed at both extremities of the body. They consist of a black pigment cup, including a spheroidal vitreous body. In several instances I observed a curious variation of the eyes in different individuals and on the different sides of the same individual. Fig. 20 repre-

sents the usual form of the cephalic eye. Figs. 21 and 22 represent the two eyes of the same individual, the right eye apparently double. Fig. 23 represents another double eye, but with the lens directed backward. Fig. 24 represents a caudal eye.

The tube of *Fabricia* is composed of exceedingly fine particles of quartzose sand and indefinite particles of mud.

I observed no specimens of this genus, exhibiting the reproductive organs in the condition usual in mature ones of *Manayunkia*.

In several instances I observed a few free eggs and young worms of 0.12 mm. in length within tubes in company with the parent, but did not have the opportunity of investigating them.

Manayunkia mainly differs from *Fabricia* in having a pair of simple or undivided tentacular lophophores instead of having them trilobate; in the possession of an inner pair of larger tentacles which receive a continuation of the main trunks of the vascular system; and in having no eyes to the terminal segment of the body.

EXPLANATION OF THE FIGURES OF PLATE IX.

FIG. 1. *MANAYUNKIA SPECIOSA*. Magnified about 50 diameters. The worm in the ordinary condition of extension, with its tentacles spread.

FIG. 2. A stock of five tubes. Magnified about 4 diameters.

FIG. 3. One of the longer podal setæ from the second setigerous segment of the body. 666 diameters.

FIG. 4. One of the shorter podal setæ, from the same. 666 diameters.

FIG. 5. A podal hook, from the same. 666 diameters.

FIG. 6. A row of podal hooks, from the last segment of the body. 250 diameters.

FIG. 7. A podal hook from the same row. 666 diameters.

FIG. 8-13. Egg and different degrees of development of the young of *Manayunkia*. 100 diameters.

FIG. 14-16. Podal setæ of *Fabricia Leidyii*, Verrill. 500 diameters.

FIG. 17, 18. Podal hooks of anterior segments. 500 diameters.

FIG. 19. Podal hook of posterior segment. 666 diameters.

FIG. 20-24. Eyes of *Fabricia*. 250 diameters.

FIG. 20. A cephalic eye of the usual form.

FIG. 21, 22. Right and left cephalic eyes of the same individual.

FIG. 23. A double cephalic eye.

FIG. 24. A caudal eye.